

Background

The second meeting of the Electronic Air Cleaners Stakeholders Group was held at RTI on October 25, 2001. The agenda is shown in Attachment 1 and the attendees in Attachment 2.

Action Items

RTI

1. RTI will write and distribute draft minutes to all attendees. The attendees will review the minutes and report to RTI any changes or additions they feel necessary. RTI will incorporate comments and then distribute the minutes to all stakeholders. A summary of the minutes will be posted on the RTI and EPA ETV web sites.
2. In the laboratory, use the silicone oil vapor exposure chamber to further evaluate the silicon dioxide deposition on the ionizing wires by comparing exposure time versus filter efficiency. EACs from various manufacturers should be used, and a single concentration of the vapor. This information is necessary in determining an endpoint for the deposition to be used in a test method.
3. Within the silicone oil exposure chamber, study factors that might affect the deposition: temperature, airflow, concentration, RH, ozone, etc. This will include a literature search as deposition has been long used for semiconductors. Do not include dust as part of deposition step.
4. The corona-enhanced chemical vapor deposition of SiO₂ on ionizing wires is top priority. Only look at dust loading if there is time and money.
5. With EPA, will look at the feasibility of measuring silicone vapor concentrations in houses.
6. In the laboratory, look at cleaning the wires (with laboratory deposits) according to manufacturer's recommendations, then running additional efficiency tests.
7. RTI will report all results in a way that will facilitate incorporation into a test method.

EPA

1. Examine the wire deposits using x-ray diffraction to determine the specific silicon compounds involved. RTI will provide a sample to EPA.

ARI

1. During the meeting, RTI asked that ARI provide feedback on which of two possible directions to be taken in the ETV program: a) continuing research or b) developing a formal, verified test protocol. At the meeting, ARI gave their response that they would like ETV to focus on research related to the SiO₂ deposition.
2. Find out how much silicone is in houses (or, based on a field study, relationship between in-house deposition and filter efficiency). Determine how data will be used for test method.
3. Look at funding a field study. Rough estimate of \$150,000. Suggested format:
 - A total of 25 houses, divided among up to 5 geographic regions. Houses could be chosen from known customer lists from the various manufacturers.
 - Initial efficiency tests (no dust loading) run on cells from each house with 0, 1, 2, 3, 6-month exposures, running fan full time. Alternatively, more houses could be used and the

exposures could be run in parallel. The efficiency tests could be run at local laboratories that routinely ran ASHRAE 52.2 tests (or all could be sent to RTI).

- The wires in the cells would be examined visually and photographically for corona and possibly microscopically to determine the nature of the deposits on the wires. This would be done all at RTI to ensure for consistency.
- The field study would require management – both for the overall project and in the field – collecting the cells, mailing them to the laboratory, and provide new cells.
- RTI would collect all the data and provide the quality assurance and statistical analysis.
- Manufacturers would provide cells for their customers taking part in the study. For most units, there are two cells used at one time for 4 tests per house (1, 2, 3, 6 months), 8 cells per house, plus a test with zero in house use.
- The goal of the project would be to have a correlation of the efficiencies (reductions) between lab deposition and real-house use.

Introductions

Dave Ensor convened the meeting at 8:30 am. All participants introduced themselves and indicated their company or what organization they represented. Attachment 2 gives the list of attendees.

Environmental Technology Verification (ETV)

Les Sparks of USEPA and Dave Ensor of RTI provided an introduction and update on the ETV program. The initial five-year program with twelve pilots ended last year. There are now six centers. RTI's indoor air ETV program continues as a pilot until next year. Protocols have been developed to test for efficiency of general ventilation air filters and for emissions from commercial furniture. An initial meeting was held for electronic air cleaners in December 1998. Dr. Ensor's viewgraphs are shown in Attachment 3.

Air Conditioning and Refrigeration Institute (ARI) Testing Program

Denise Beach presented an update on the ARI program. They are working to revise the appropriate standards and to develop a certification program for installed air cleaners.

Electronics Air Cleaners (EACs)

At the first stakeholder meeting there was agreement on the definition of the product to be tested. An EAC is defined to:

- have a cord (active electrical current),
- be intended for residential or light commercial use (up to 2000 CFM) and
- be ducted.

At that time, RTI agreed to look at issues related to the development of a test protocol. Jim Hanley presented the results of the RTI research focused on

- dust loading capacity for media filters, to provide a comparison for how much dust would be reasonable to use for EACs, which don't have a pressure drop to use for an endpoint.
- efficiency testing of EACs used in residential setting, to ensure that the laboratory testing would model the use in a residence.
- the dust used for efficiency test. There has been concern that dust containing carbon black shorts out electronic air cleaners.

The presentation is shown in Attachment 4.

Dust

To provide initial estimates of how much dust would be reasonable to challenge an EAC with, RTI measured how much dust it takes to load up furnace filters intended for use in the same application (i.e., residential HVAC systems). Eight different media furnace filters were loaded with ASHRAE dust and ASHRAE dust without carbon. For each test, the amount of dust needed (known as “dust fed”) to bring the pressure drop of the filter up to 0.6 and 1.0 in. H₂O was recorded. The overall weight gain of the filter after loading to 1 in. was also determined. All of the test filters had nominal dimensions of 20 x 20 x 1 in. and were run at 820 cfm.

Results from these tests showed that dust fed quantities ranged from 16 to 103 grams (average of 63 grams) to reach 0.6 in. pressure drop and from 25 to 127 grams (average 86 grams) to reach 1.0 in. H₂O.

For ASHRAE dust without carbon, the dust fed ranged from 58 to 282 grams (average of 156 grams) to reach 0.6 in. H₂O and ranged from 84 to 322 (average of 182 grams) to reach 1.0 in. H₂O.

RTI loaded up to 320 g of dust (AC fine) on two different EACs. There was very little effect on the efficiency. Optical microscopy showed that little if any dust was being collected on the ionizing wires. Visual observation of the cells in a dark room showed a uniform corona on all wires, identical to that observed for clean cells.

The makeup of the dust was not studied as part of this work, although RTI is currently doing a literature search on dust for ASHRAE.

Residential

One house with an existing EAC was used for the study. New cells were provided so that cells used for 1 month, 2 months and 3 months could be tested. RTI observed that there was a white deposit on the ionizing wires. The wires were observed using a scanning electron microscope (SEM) with energy dispersive x-ray (EDX) analysis; the deposits were silicon oxides, an insulator. With the deposit on the wires, the corona effect was reduced, thus reducing the filter efficiency. Vapor deposition of silicon oxides has been reported on ionizing wires previously.

A vapor exposure duct was set up, so that a vapor could be generated from a silicone oil (Dow Corning 244). 19-hour exposures for two different EACs were followed by efficiency testing. There were reductions in efficiency similar to what was seen in cells with residential use, however, it was determined that 19 hours was too long of an exposure. Examination of the wire via SEM and EDX showed deposits of silicon oxide having a morphology similar to the residential-exposed wires.

Discussion

RTI was asked about the source of the silicon. Silicone-based products are used in a wide range of products, including personal care products such as hair care products, skin care products, deodorants and cleaners. Silicone surfactants are used in or with cleaners, pesticides, paint

additives, and synthetic fibers. There are silicone caulking products, food packaging, lubricants for fiber extrusions (such as carpeting) and medical devices. The various products differ in chemical composition and in vapor pressure. None of the participants know of studies of silicone vapors concentrations in houses.

It was stated that there is a wide variance in silicone vapor levels among houses. While the deposition does affect the electrical current levels of the EAC, there is not necessarily a direct correlation, so that EAC current cannot be used as the measure of the filter efficiency.

Once the wires have a deposit that reduces the filter efficiency below a satisfactory level, then the cells need to be cleaned. Cleaning recommendations vary, but may include wiping the wires. The wires are generally made of tungsten, but deposits occur on other wire materials as well.

The attendees agreed that they did want the loading dust to be addressed, seeing this as a secondary effect on EAC performance relative to the more dominant effect of SiO₂ deposits on the ionizing wires. There are still concerns about the carbon in the dust and how much dust should be loaded (i.e., endpoint for testing). This would likely be done after conditioning issues were handled. There is also a concern about whether dust affects the SiO₂ buildup. At the present time, particle sizes of 0.3 µm to 10 µm will be included, as they are in the ASHRAE 52.2 standard.

As RTI only ran an EAC in one house, there was discussion of doing a more extensive field study with multiple houses in different locations. This could not be funded under the current RTI cooperative agreement with EPA, but perhaps ARI could find funding for such a project. 25 houses in 5 locations were discussed, with all vendors participating. Run times of 1, 2, 3, and 6 months could be used. Laboratory exposure would also occur, so that there could be better information for conditioning: how long should an EAC be exposed in the laboratory to represent a certain time in the field.

Cleaning schedules and procedures were discussed. Cleaning recommendations range from 2 to 6 months with standard use; more often if pollutants are heavy, such as in new construction. Time that the fan is running is definitely a factor, rather than calendar time or furnace/AC run time. Cleaning procedures include using a dishwasher, washing by hand, and wiping by hand. Test results should give vendors and consumers information that helps them determine cleaning interval related to filter efficiency.

At least two of the companies represented at the meeting have air cleaners that include filter media in addition to an active electrical current. It is not clear for some of these products whether there would be a reaction with silicone. The current ETV work will not specifically address these devices.

Attachment 1. Agenda

Environmental Verification Program for Indoor Air Products Stakeholder Meeting for Electronic Air Cleaners RTI, October 25, 2001 Agenda

8:30	Welcome and Introductions <i>All attendees are requested to indicate the organization they are representing, stakeholder role, source of funding and their expectations with respect to the outcome of this meeting.</i>	Dave Ensor
9:00	EPA Environmental Technology Verification	Les Sparks Dave Ensor
9:30	ARI programs	
10:00	Break	
10:15	Report of Preliminary ETV testing Dust loading, effect of using different dusts for testing, testing EACs used in real buildings	Jim Hanley
11:00	Draft Test Protocol, revisions to ASHRAE 52.2	Jim Hanley
12:00	Working lunch	
1:00	Verification/private program discussion	All
3:00	Action items	Dave Ensor
3:30-4:00	Adjourn	

Attachment 2. Attendees

Al Barsimanto, Air Ion Devices (T)
Denise Beach, ARI
Eric Brodsky, Research Products
Barney Burroughs, representing ASHRAE
Damon Drumm, White-Rodgers (T)
Teresa Dimorier-Peck, Interek Testing Services
Dave Ensor, RTI
Debbie Franke, RTI
Jim Hanley, RTI
Tim Kensok, Honeywell
Phil Lawless, RTI
Ron Miles, White-Rodgers (T)
Kathleen Owen, RTI
John Riley, Skuttle IAQ Products
Charles Rose, AAF International
John Sabelli, Intertek Testing Services
Bill Schockley, White-Rodgers (T)
Les Sparks, USEPA
Gene Tatsch, RTI (T)
Shirley Wasson, USEPA

(T) – participated by telephone and web